

# BMJ Open Caesarean sections and for-profit status of hospitals: systematic review and meta-analysis

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## ABSTRACT

**Objective:** Financial incentives may encourage private for-profit providers to perform more caesarean section (CS) than non-profit hospitals. We therefore sought to determine the association of for-profit status of hospital and odds of CS.

**Design:** Systematic review and meta-analysis.

**Data sources:** MEDLINE, EMBASE and the Cochrane Database of Systematic Reviews from the first year of records through February 2016.

**Eligibility criteria:** To be eligible, studies had to report data to allow the calculation of ORs of CS comparing private for-profit hospitals with public or private non-profit hospitals in a specific geographic area.

**Outcomes:** The prespecified primary outcome was the adjusted OR of births delivered by CS in private for-profit hospitals as compared with public or private non-profit hospitals; the prespecified secondary outcome was the crude OR of CS in private for-profit hospitals as compared with public or private non-profit hospitals.

**Results:** 15 articles describing 17 separate studies in 4.1 million women were included. In a meta-analysis of 11 studies, the adjusted odds of delivery by CS was 1.41 higher in for-profit hospitals as compared with non-profit hospitals (95% CI 1.24 to 1.60) with no relevant heterogeneity between studies ( $\tau^2 \leq 0.037$ ). Findings were robust across subgroups of studies in stratified analyses. The meta-analysis of crude estimates from 16 studies revealed a somewhat more pronounced association (pooled OR 1.84, 95% CI 1.49 to 2.27) with moderate-to-high heterogeneity between studies ( $\tau^2 \geq 0.179$ ).

**Conclusions:** CS are more likely to be performed by for-profit hospitals as compared with non-profit hospitals. This holds true regardless of women's risk and contextual factors such as country, year or study design. Since financial incentives are likely to play an important role, we recommend examination of incentive structures of for-profit hospitals to identify strategies that encourage appropriate provision of CS.

## INTRODUCTION

Caesarean section (CS) has greatly improved perinatal outcomes by reducing newborn and

## Strengths and limitations of this study

- Major strengths of our meta-analysis include a broad literature search, screening and data extraction performed in duplicate, careful exclusion of studies with overlapping populations and an exploration of study characteristics as a potential source of variation between studies.
- A major limitation of our meta-analysis lies in the variation between studies in design, number of hospital units involved, size and characteristics of study population, type of data used, outcome measure and variables used in statistical analysis. Despite these differences, the results of the meta-analysis of adjusted estimates were surprisingly consistent.

maternal mortality,<sup>1</sup> but the increasing frequency of CS has raised concerns, particularly when performed in the absence of clear-cut medical indications.<sup>2 3</sup> Organisation for Economic Co-operation and Development (OECD) data reveal an average annual increase of 0.66% in member countries,<sup>4</sup> and similar trends are evident elsewhere.<sup>2</sup> A recent analysis of national CS rates found that rates up to 19% were inversely correlated with maternal and neonatal mortality.<sup>5</sup> Many countries have CS rates higher than 19%, even though there is no evidence to suggest that higher rates are associated with further decreases in maternal and neonatal mortality.<sup>5 6</sup> In Brazil, for example, CS rates are estimated at 46%.<sup>7</sup> Higher CS rates increase the cost of care<sup>3 8</sup> and may have negative effects on the health of mothers<sup>9</sup> and newborns.<sup>10</sup>

CS rates vary considerably across regions and hospitals within countries, and a closer look at this variation may help to identify factors that contribute to higher than necessary rates.<sup>2</sup> CS receive higher reimbursement than normal vaginal births in most health-care systems.<sup>11 12</sup> We therefore hypothesised that financial incentives encourage private

providers with an emphasis on profit to perform more CS than non-profit hospitals, and conducted a systematic review and meta-analysis to determine the association of for-profit status with the odds of delivery by CS.

## METHODS

### Data sources

We searched MEDLINE, EMBASE and the Cochrane Database of Systematic Reviews from inception to 8 February 2016, when the search was last updated. We combined search terms referring to CS, such as 'operative delivery', 'C section', 'Cesarean', 'Cesarean delivery', with search terms related to the design of studies such as 'small area analysis', 'medical practice variation', and search terms related to determinants of variation and increase of CS rates. We did not restrict searches by type of language or publication date. Full details are given in online supplementary appendix 1. In addition, we manually searched the reference lists of all included studies and earlier systematic reviews that we identified.

### Study selection and outcomes

To be eligible studies had to report data to allow the calculation of ORs of CS comparing private for-profit hospitals with public or private non-profit hospitals in a specific geographic area. The prespecified primary outcome was the OR of births delivered by CS in private for-profit hospitals as compared with public or private non-profit hospitals adjusted for confounding factors as specified by individual investigators. The prespecified secondary outcome was the crude OR of CS in private for-profit hospitals as compared with public or private non-profit hospitals. Studies were included if they reported data on either primary or secondary outcome.

### Data extraction

Two researchers (IH and XL) screened the papers and extracted data independently. Articles that were not published in English were reviewed by authors with knowledge of those languages. Differences were resolved by consensus. Data from full-text articles were extracted onto a data extraction sheet designed to capture data on study population (history of previous CS, parity, risk factors for CS, characteristics of newborn), study design (size, sampling strategy, cross-sectional vs retrospective cohort study), data sources (birth registries, hospital records, surveys, insurance claims or census data), setting (country and period of data collection), type of CS analysed (indication for CS established before labour (ie, planned), indication for CS established during labour, any CS irrespective of indication) and statistical analysis (including variables adjusted for). We extracted adjusted and/or unadjusted ORs of CS in private for-profit hospitals as compared with CS in public or private non-profit hospitals.

## Analysis

We used standard inverse-variance random-effects meta-analysis to combine ORs overall and stratified by type of reference group (ie, public or private non-profit hospitals). An OR above 1 indicates that CS are more frequently performed in private for-profit hospitals than in public or private non-profit hospitals. We calculated the variance estimate  $\tau^2$  as a measure of heterogeneity between studies.<sup>13</sup> We prespecified a  $\tau^2$  of 0.04 to represent low heterogeneity, 0.16 to represent moderate and 0.36 to represent high heterogeneity between studies.<sup>14</sup> We conducted analyses stratified by study design (cross-sectional vs retrospective cohort study), national CS rates (moderate, high, very high), period of data collection (up to 1994, between 1995 and 2004, 2005 and later), parity (primiparae and multiparae combined vs primiparae only), history of previous CS and type of CS analysed (indication for CS established before labour (ie, planned CS), indication for CS established during labour, any CS irrespective of indication) to investigate potential reasons for between-study heterogeneity and used  $\chi^2$  tests to calculate p values for interaction, or tests for linear trend in case of more than two ordered strata. National CS rates were classified into moderate (>15% to 20%), high (>20% to 40%) and very high (>40%) based on data reported by the WHO.<sup>5</sup> All p values are two-sided. We used STATA, release V.13, for all analyses (Stata-Corp, College Station, Texas, USA).

### Patient involvement

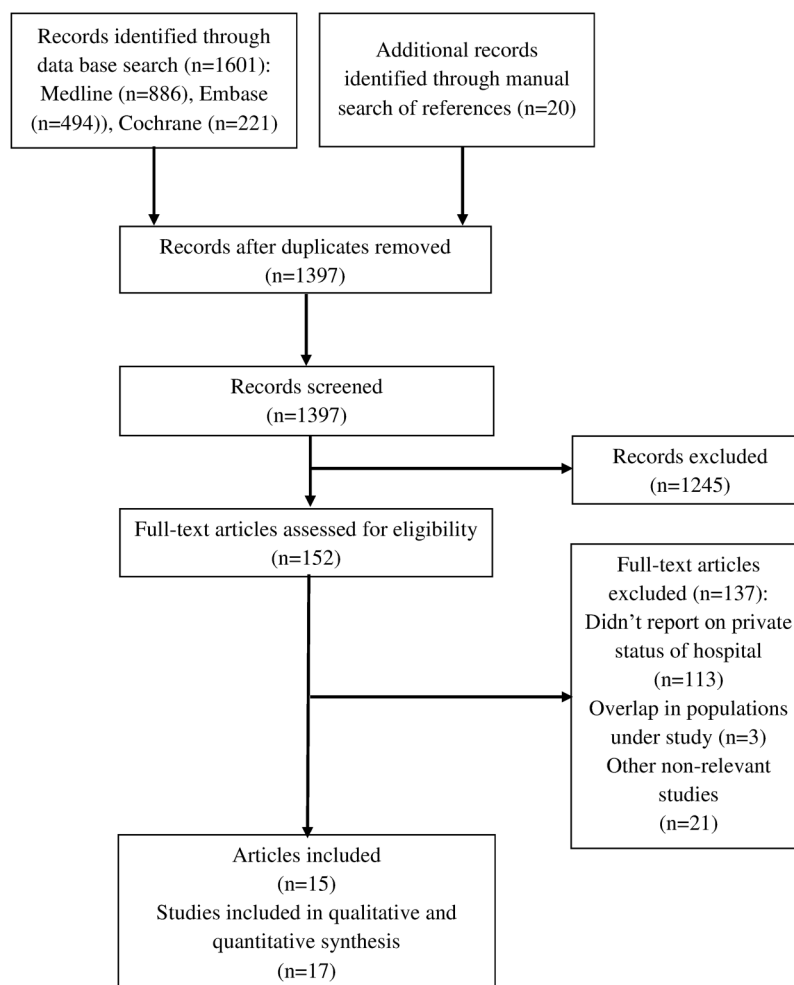
No patients were involved in this study.

## RESULTS

A total of 1621 records were identified by our search (figure 1): 886 from MEDLINE; 494 from EMBASE; 221 from the Cochrane Database of Systematic Reviews and 20 from manual search. After removing duplicates, we screened 1397 records for eligibility, retained 373 records for a more careful examination of titles and abstracts, and excluded another 221 records because they failed to match eligibility criteria. We assessed the full texts of the 152 remaining records and excluded another 113 that did not report private status of hospital, 21 that were otherwise irrelevant and 3 studies that had an overlapping population. This left us with a total of 15 articles describing 17 separate studies in 4.1 million women that were included in review and meta-analysis.

Characteristics of studies and populations are presented in table 1 and online supplementary appendices 2–4. Fifteen studies were cross-sectional, and two were retrospective cohort studies. All studies were published in English, except for one study in French. Most studies were from France (4) and the USA (4). Exclusion criteria varied considerably: 4 studies excluded girls aged 14 or below, 3 excluded multiparas, 7 excluded women with previous CS, 13 excluded stillbirths and multiple births, 5 excluded cases with specific presentations of

**Figure 1** The flow diagram of review.



the fetus, and 5 studies excluded cases with other high risk factors for CS; 15 studies excluded preterm births. Twelve studies included the entire population of eligible cases, while five studies selected cases randomly. Seven studies used surveys, nine hospital records, four birth registries, two insurance claims and one census data. Five studies reported ORs of CS with indications established before labour (including CS on maternal request) only, 2 reported CS with indications established during labour and 10 reported ORs of any CS. Online supplementary appendix 4 presents the characteristics that estimates were adjusted for. Among 11 studies reporting adjusted estimates, the median number of characteristics adjusted for was 8 (range 2–124).

Figure 2 presents the meta-analysis of the 11 studies that reported adjusted ORs,<sup>15–25</sup> with 6 studies using public non-profit hospitals as reference group, three private non-profit hospitals and two using both. Overall, the odds of receiving CS was 1.41 times higher in for-profit hospitals as compared with either of the two types of non-profit hospitals (95% CI 1.24 to 1.60), with no relevant heterogeneity between studies ( $\tau^2 \leq 0.037$ ) and little evidence for an interaction between estimated ORs and type of reference group (p for interaction=0.20). Figure 3 presents results of stratified analyses of adjusted

ORs. Estimates varied to some extent between strata, but all tests for interaction or trend across subgroups were negative. Pooled estimates ranged from 1.20 to 1.62 across subgroups. There was little evidence to suggest secular trends (p for trend=0.13) or an association of ORs with national CS rates (p for trend=0.18). Figure 4 presents the meta-analysis of crude ORs with moderate-to-high heterogeneity between studies ( $\tau^2 \geq 0.179$ ), a somewhat more pronounced average association (pooled OR 1.84, 95% CI 1.49 to 2.27) and again little evidence for an interaction between estimated ORs and type of reference group (p for interaction=0.48).

## DISCUSSION

Our systematic review and meta-analysis indicates that the odds of receiving a CS are on average 1.4 times higher in private for-profit hospitals than in non-profit hospitals. Findings were robust across all subgroups of studies in stratified analyses. In particular, there was little evidence to suggest secular trends or an association with national CS rates. Even though, a test for trend across periods of data collection was negative, we found the association between for-profit status of hospitals and

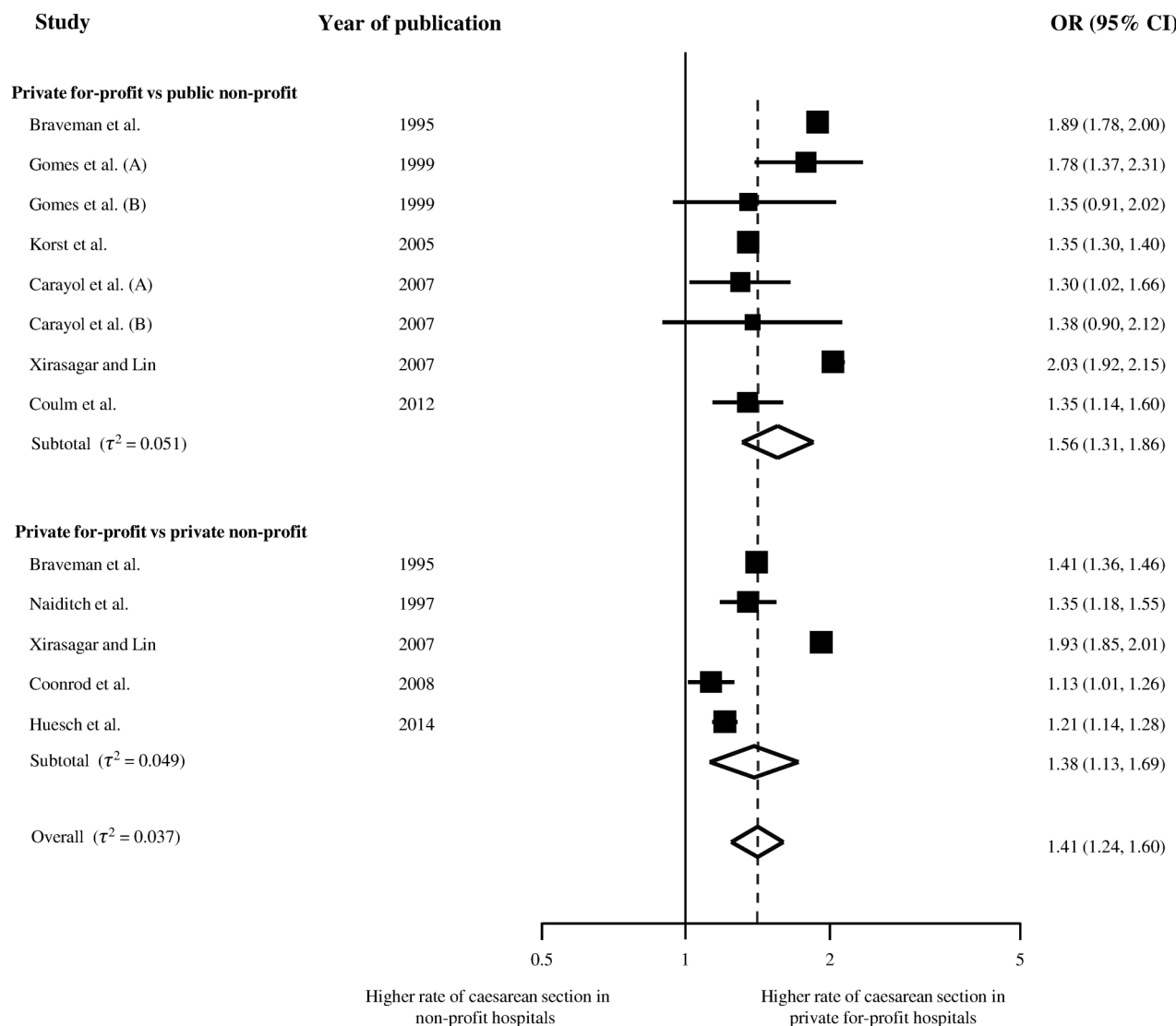
**Table 1** Characteristics of included studies

Author	Year	Country	Study design	Number of cases	Number of hospital units	Year of data collection	Population	Sampling	Type of CS analysed	National CS rates*
Braveman <i>et al</i>	1995	USA	Retrospective cohort study	213 761	Unclear	1991	Primiparae; no previous CS; any risk	Consecutive	Any	High
Naiditch <i>et al</i>	1997	France	Cross-sectional	39 880	944	1991	Primiparae and multiparae; no previous CS; any risk	Random	Before labour	Moderate
Gomes <i>et al. A</i>	1999	Brazil	Cross-sectional	6750	8	1978–1979	Primiparae and multiparae; with or without previous CS; any risk	Consecutive	Any	Very high
Gomes <i>et al. B</i>	1999	Brazil	Cross-sectional	2846	10	1994	Primiparae and multiparae; with or without previous CS; any risk	Consecutive	Any	Very high
Gonzalez-Perez <i>et al</i>	2001	Mexico	Cross-sectional	1 716 446	Unclear	1994–1997	Primiparae and multiparae; with or without previous CS; any risk	Consecutive	Any	High
Korst <i>et al</i>	2005	USA	Cross-sectional	443 532	288	1995	Primiparae and multiparae; no previous CS; any risk	Consecutive	During labour	High
Mossialos <i>et al.</i>	2005	Greece	Cross-sectional	805	3	2002	Primiparae and multiparae; with or without previous CS; any risk	Consecutive	Any	High
Carayol <i>et al A</i>	2007	France	Cross-sectional	1479	Unclear	1972, 1995, 1998, 2003	Primiparae and multiparae; no previous CS; high risk	Random	Before labour	Moderate
Carayol <i>et al B</i>	2007	France	Cross-sectional	6080	138	2001-2002	Primiparae and multiparae; no previous CS; high risk	Random	Before labour	Moderate
Xirasagar and Lin	2007	Taiwan	Cross-sectional	739 531	942	1997–2000	Primiparae and multiparae; with or without previous CS; any risk	Consecutive	Before labour†	High
Coonrod <i>et al</i>	2008	USA	Cross-sectional	28 863	40	2005	Primiparae; low risk	Consecutive	Any	High
Coulm <i>et al</i>	2012	France	Cross-sectional	9530	535	2010	Primiparae and multiparae; no previous CS; low risk	Consecutive	Any	Moderate
Huesch <i>et al</i>	2014	USA	Cross-sectional	408 355	254	2010	Primiparae and multiparae; no previous CS; any risk	Consecutive	Before labour	High
Raifman <i>et al A</i>	2014	Brazil	Cross sectional	4918	Not Reported	1996	Primi- and multiparae; with or without previous CS; any risk	Random	Any	Very high
Raifman <i>et al B</i>	2014	Brazil	Cross sectional	5768	Not Reported	2006	Primi- and multiparae; with or without previous CS; any risk	Random	Any	Very high
Schemann <i>et al</i>	2015	Australia	Cross sectional	61 894	81	2007-2011	Multiparae; with previous CS	Consecutive	Any	High
Sebastião <i>et al</i>	2016	USA	Retrospective cohort study	412 192	122	2004-2011	Primiparae; low risk	Consecutive	During labour	High

\*National CS rates classified according to WHO data reported for 2008 into moderate (>15% to 20%), high (>20% to 40%) and very high (>40%).

†On maternal request.

CS, caesarean section.



**Figure 2** Adjusted ORs of caesarean section.

odds of CS less pronounced in recent years. In view of the negative test for trend, this could be a chance finding. Alternatively, this may reflect attempts of care providers and policymakers to attenuate raising CS rates over time.

### Context

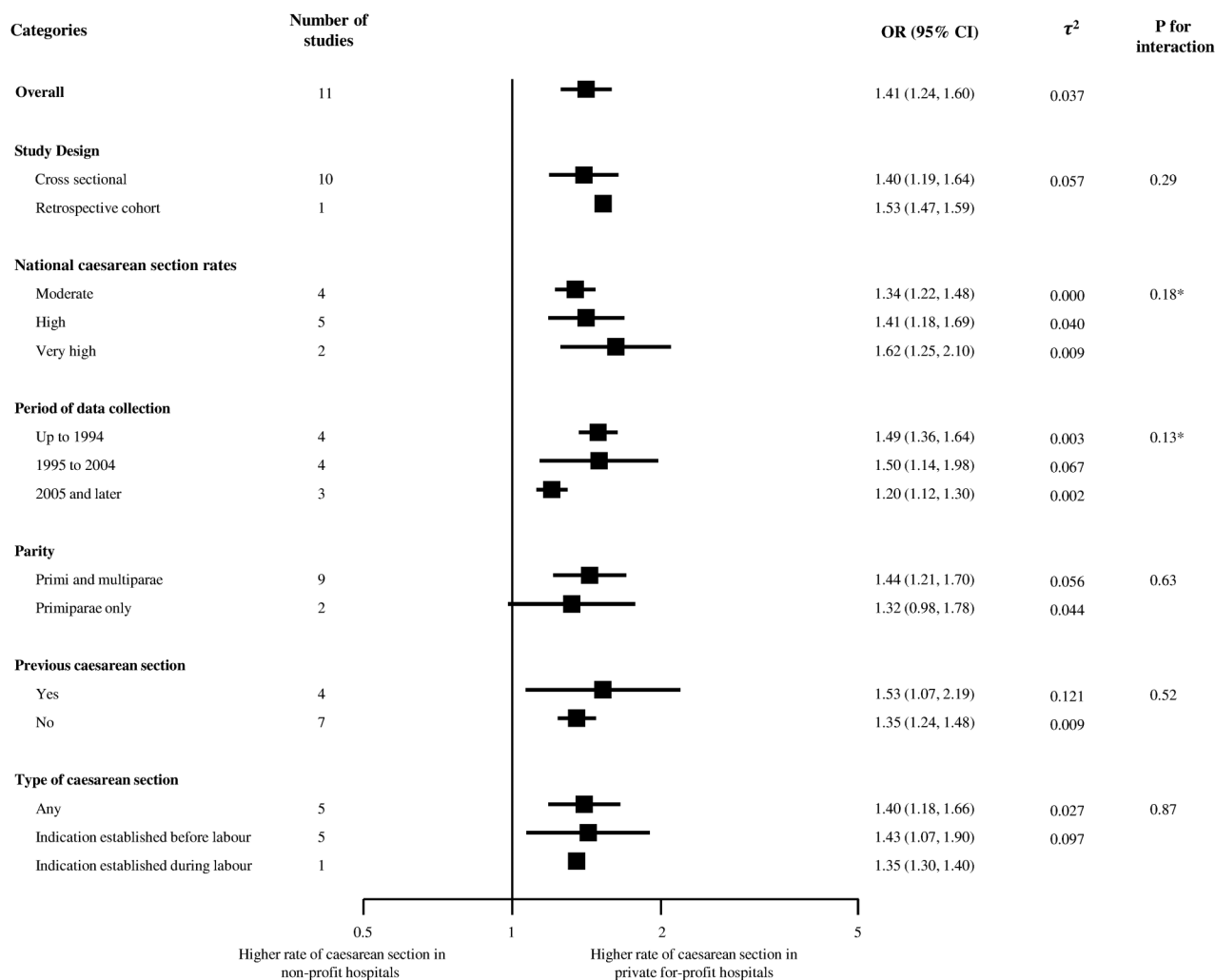
To our knowledge, this is the first meta-analysis to address the association of CS rates with for-profit status of hospitals. We are aware of three recent meta-analyses that examined the association of CS rates with obesity,<sup>26</sup> ethnic origin<sup>27</sup> and labour induction.<sup>28</sup> In a meta-analysis of unadjusted estimates from prospective and retrospective cohort studies, Poobalan *et al*<sup>26</sup> found a 53% increase in the odds of CS associated with maternal overweight and a 126% increase with obesity. Merry *et al*<sup>27</sup> found a 41% increase in the adjusted odds of CS associated with sub-Saharan African origin, and a 99% increase associated with Somali origin of women. Estimates for South, North-African/West Asian and

Latin American women were similar but statistically not significant. Finally, in a meta-analysis of randomised trials, Mishanina *et al*<sup>28</sup> found expectant management to be associated with a 14% increase in the risk of CS. Our meta-analysis indicates agreement across 17 studies performed in seven countries as to the direction of this association, even though the magnitude of the association shows some variability. Our pooled estimate of a 41% increase in adjusted odds of CS associated with for-profit status of hospital has a similar or larger magnitude than the associations found for the characteristics above and therefore appears relevant for clinical and policy decision-making.

### Strengths and limitations

A major limitation of our meta-analysis lies in the variation between studies in design, number of hospital units' involved, size and characteristics of study population, type of data used, outcome measure and variables used in statistical analysis. Despite these differences, the



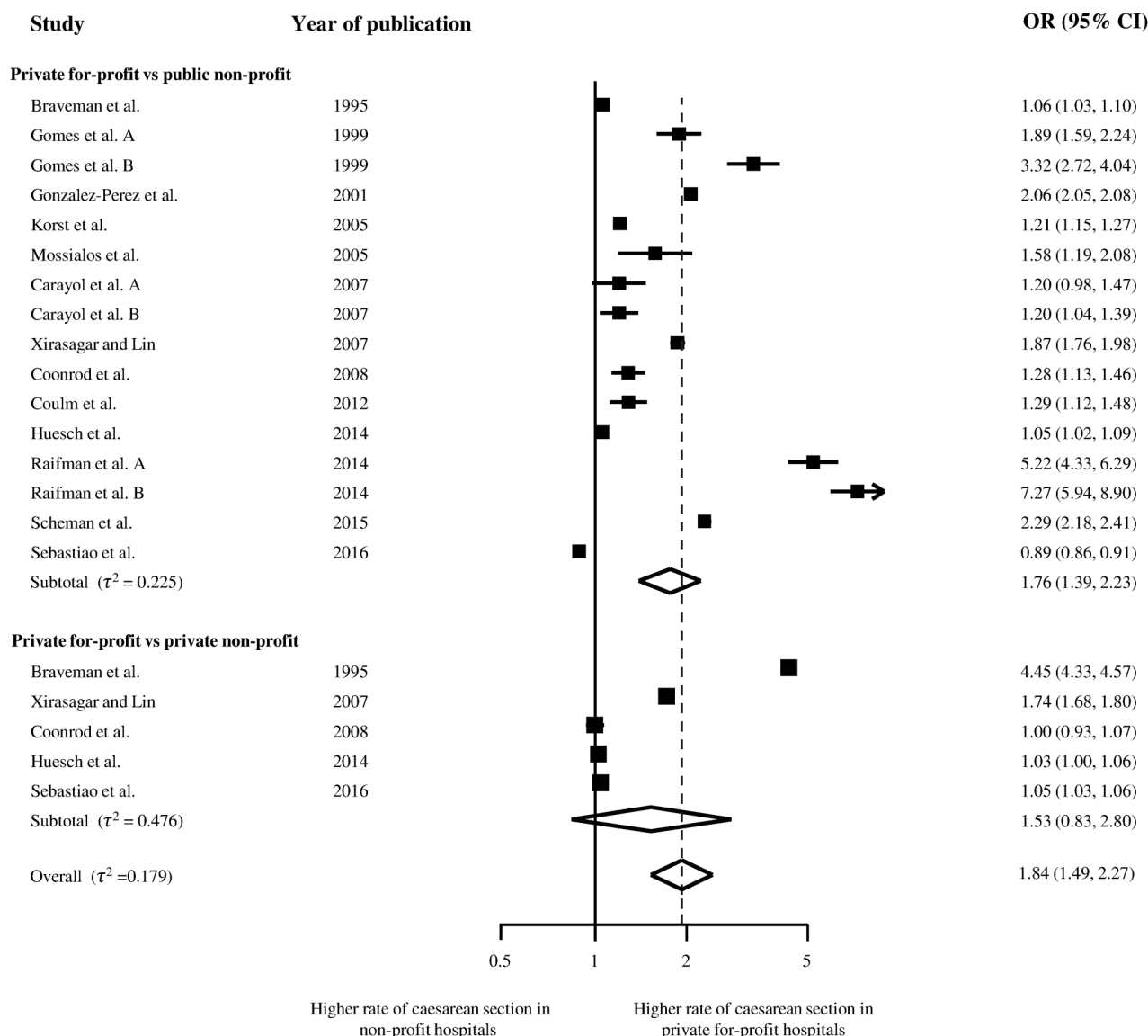


**Figure 3** Stratified analyses. \*p Value for linear trend.

results of the meta-analysis of adjusted estimates were surprisingly consistent. Conversely, unadjusted estimates showed considerable heterogeneity between studies, which suggests confounding by medical and non-medical factors as a reason for variation between studies. Among these factors are socioeconomic status, preferences and clinical condition of women, fetus characteristics, medical care during pregnancy and delivery as well as physician, hospital and health system characteristics.<sup>2</sup> Professionals often attribute higher rates of procedures to the gravity of clinical conditions of patient receiving an intervention. This argument is not supported by the data of this review as associations of CS rates with for-profit status were consistently found in analyses adjusted for a wide range of risk factors (see online supplementary appendix 4). Major strengths of our meta-analysis include a broad literature search, screening and data extraction performed in duplicate, careful exclusion of studies with overlapping populations and an exploration of study characteristics as a potential source of variation between studies.

## Mechanisms

Financial incentives are likely to contribute to the observed association. The literature has described the influence of supply factors in the type and amount of care provided for a given condition.<sup>29–32</sup> Private for-profit institutions may create financial incentive structures that encourage more resource-intensive<sup>33</sup> and expensive procedures,<sup>11 34–36</sup> since that will increase their profits. The payment model of hospitals and physicians is another important factor.<sup>11 32 34 35 37</sup> Fee for service reimbursement may be more common for private for-profit hospitals and will encourage hospitals and physicians to provide more procedures than medically indicated<sup>38–40</sup> and increase time pressure on physicians to perform CS instead of waiting longer for a normal birth.<sup>41 42</sup> Health insurers can also encourage overprovision of CS as they tend to reimburse hospitals and physicians better for CS than for vaginal delivery.<sup>11 43 44</sup> Finally, private for-profit institutions typically have a higher number of qualified physicians, more resources and better infrastructure,<sup>2 32 45–47</sup> which will



**Figure 4** Crude ORs of caesarean section.

encourage overprovision of care in private for-profit institutions.

### Implications for research

Although immediate steps to improve clinical decision-making for CS should not be delayed, further research would inform the persistent dilemma of misalignment between good care and financial incentives. Since financial incentives differ across and within countries, there is a need for additional context-specific investigation of the economic drivers of overuse.<sup>48</sup> Policy analysis focusing on for-profit hospitals should examine further the interplay of specific factors for each country or, ideally, individual contracts between insurers and providers within countries to identify financial incentives that cause private for-profit hospitals to perform more CS than non-profit hospitals. Such analyses should explore if financial incentives interact at the physician level, such as physician payment schemes, or at the hospital level,

including informal or formal pressure on physicians to choose more expensive procedures or save time by performing a CS instead of waiting longer for a normal birth. In some countries, such analyses should also extend to not for-profit hospitals, if fee for service payments are used regardless of for-profit status. The effects of the level and type of government regulation of hospitals, type of health insurance and implementation of clinical guidelines also require further study.

### Implications for policymaking

The persisting increase of CS rates in many health systems despite the growing recognition of CS overuse suggests that current clinical guidelines are not sufficient.<sup>2</sup> Improving clinical decision-making by providing clear clinical guidelines that are evidence based would be one step forward. Equally important is the alignment of financial incentives with the objective to improve care without increasing costs. The higher odds of CS in the for-profit sector suggest that

physicians and hospitals are responsive to financial incentives. Changing reimbursement policies so that vaginal deliveries and CS are paid similarly could keep overall payments to physicians and hospitals approximately constant without encouraging unnecessary CS but will not guarantee an elimination of overuse. Negative incentives, such as penalising hospitals for high CS rates could also be considered, but require monitoring for unintended consequences.<sup>49</sup> A decrease of unnecessary CS, a cost-effective use of resources and improved health outcomes for mothers and newborns should be the ultimate goal.

## CONCLUSION

This systematic review and meta-analysis indicates that CS are more likely to be performed in for-profit hospitals as compared with non-profit hospitals. This holds true regardless of women's risk and contextual factors such as country, year or study design. Since financial incentives are likely to play an important role, we recommend examination of incentive structures, including reimbursement schemes of for-profit hospitals, to identify strategies that encourage best clinical judgement and outcome rather than rewarding expensive procedures that are clinically unnecessary and potentially harmful for mothers and newborns.

**Contributors** IH, DCG and PJ have developed the idea for the study. IH, XL and DCG were involved in the study conception, preliminary literature review and design of the search strategy and the study protocol. IH, LS and XL were involved in screening and data extraction of papers. All authors reviewed data extraction output. IH, LS, BRdC and PJ designed and performed the meta-analysis. IH, LS, KT, BRdC and PJ drafted the report, which was critically reviewed and approved by all authors.

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